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Augmented AODV Using Clustering in VANET

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Abstract—

A vehicular ad hoc network (VANET) is a class of Mobile Ad hoc Network (MANET). VANET uses vehicles in order to form a mobile network. In such a network the vehicles share information with each other by communicating with each other which in turn help to reduce a number of accidents on road. Using the wireless medium the data packets are broadcasted. Due to all this reason the communication in VANET is very insecure. Several routing protocols are used in VANET. Among all the routing protocols, Ad-hoc on demand distance vector (AODV) is the most common routing protocol. This protocol has several advantages. But when we talk about VANET certain special features should be present in the protocol that make the communication more secure and stable. In order to make AODV more suitable for the VANET environment we can add the clustering feature to it. Clustering algorithm ensures secure communication. This provides a clustering algorithm which when combined with AODV routing protocol can improve the performance of the original AODV. With the help of this paper we will be able to understand the advantages that a clustering algorithm can provide to routing protocol.

Keywords*— *Vehicular ad hoc network, Clustering, Cluster head, Gateway, Ad-hoc on demand distance vector.

I. INTRODUCTION

VANET is a unique category of Mobile Ad hoc network (MANET) that uses vehicles for the formation of the network. Internet-connected cars are the result of this new growing technology called Vehicular ad hoc network. Vehicles running on the road results into the construction of the network called VANET. There are several benefits of such a network such as it help to prevent accident, helps to reduce congestion etc. Thus such a network is more safe and secure. One of the most important feature of this network is that it helps a vehicle to run without a driver. This in turn helps to reduce the driving time and it also helps to save energy. The vehicles which inherent such a technology can easily search for the vacant spot in the parking area. This helps to reduce the fuel consumption and also to save time. This technology enable for the communication which is much more faster than the human to human communication. This technology helps to decrease the amount of accident on road.

One of the problem in the vehicular ad hoc network is the problem of fake entries in the network. There are chances of the creation of the congestion in the network due to the dynamic nature of vehicles. In order to solve all such problems several solution have been suggested. Among all such solution clustering is one of the technique. Clustering [9] provide other benefits also such as it helps to decrease the message count, increase network connectivity etc.

In order to solve the problems of VANET and also to enhance the performance of AODV routing protocols we have added the feature of clustering to AODV. Thus this paper proposes a new data forwarding scheme based on the clustering and AODV Routing protocol. In our clustering algorithm we have used two parameters namely direction and time duration for the receipt of the acknowledgement (ack) message (msg). In the proposed algorithm, the cluster head manages a cluster and gateway manages the communication between two clusters. Compared with AODV Routing, it is expected that the network resources are efficiently utilized using augmented AODV. Finally, we will show the effectiveness of the proposed clustering algorithm through simulation evaluation using network simulator.

II. AUGMENTED AODV USING CLUSTERING

In our work we have made an attempt to enhance the performance of the AODV routing protocol. In order to complete our motive we added the feature of cluster formation to the vehicular ad hoc network. Then due to this cluster formation the performance of the AODV routing protocol will be enhanced. We all know that cluster can be formed using various set of parameters. In our approach also we have taken two parameters.

A. Cluster Formation

For the cluster formation we have taken two parameters. They are:

- Time duration for the receipt of the acknowledgement (ack) message (msg).
- Direction.

B. Algorithm Used

Input : parameter of the nodes
Output: Cluster of the network
Step 1 : Check direction of the node.
Step 2 : If same direction

Goto step 3
Else
Goto step 16
Step 3 : Send HELLO msg to all nodes
Step 4 : Set up threshold value for wait (w) time of receipt of ack msg.
Step 5 : Wait for ack msg.
Step 6 : On receipt of ack msg:
If (w.time <= threshold)
Form cluster
else
Goto step 16
Step 7 : Elect cluster head using w.time
Step 8 : Select gateway using w.time
Step 9 : Enable communication
Step 10: Calculate throughput for augmented AODV and original AODV
Step 11: Calculate PDR for augmented AODV and original AODV
Step 12: Calculate NRL for augmented AODV and original AODV
Step 13: Repeat Step 10-12 for node speed set to 5m/s, 10m/s,15m/s, 20m/s, 25m/s
Step 14 : Plot the graph on the basis of the values obtained from step 10 to 13
Step 15: Conclude the comparative analysis result
Step 16: Stop

In our algorithm the cluster head is elected by comparing the average wait time for each node within a cluster. On comparing which ever node will have the minimum average wait time will be elected as cluster head.
The next step after the formation of the cluster is to assign different role to the nodes in the cluster. They are:

- Cluster head: Cluster head is responsible for the management of the nodes inside the cluster. It is also responsible for the regulation of the number of nodes within a cluster.
- Gateway: Gateway is responsible for the management of the inter cluster communication.
- Cluster Member: Rest of the remaining nodes within a cluster are called the cluster member.

C. Communication

Once the role are assigned to the various nodes present in the cluster the next step is to enable the communication within the cluster and between two cluster.

1) *Within a cluster*: For communication within a cluster the flow of data packets will take place via the cluster head. It means that within a cluster the cluster member and gateway will send updated data packets to the cluster head. Similarly the cluster head will send updated data packets to the cluster member and gateway. In this way all the vehicles within a cluster will remain updated with same data packets.
2) *Between two clusters*: When a node in one cluster wants to communicate to a node in another cluster, then this communication will take place via the gateway. Suppose there are two clusters A and B. If a node 1 in cluster A (with cluster head 2 and gateway 3) wants to send message to node 4 in cluster B (with cluster head 5 and gateway 6), then the data packet will flow as 1 to 2 to 3 to 6 to 5 to 4.

III. SIMULATION

In this section, we present our simulation. Using the simulation we will be able to show the effectiveness of our proposed algorithm. All simulations are executed using NS-2 version 2.35. Table I lists simulation parameters settings configured in the simulator.

TABLE I SIMULATION PARAMETERS

TITLE	DESCRIPTION
Simulation Area	800m X 800m
Simulation Time	150 simulation seconds
Wireless nodes	16
Routing Protocols	AODV
Interface queue type	Queue/DropTail/PriQueue
MAC Protocol	Mac/802.11
TCP Packet size	1024 bytes
Transport protocol	TCP
Channel type	Channel/wireless channels
Radio propagation model	Propagation/TwoRayGround
Network interface type	Phy/WirelessPhy
MAC protocol	Mac/802.11
Antenna model	Antenna/OmniAntenna
Vehicle speed	5m/s, 10m/s, 15m/s, 20m/s, 25m/s

IV. RESULT AND ANALYSIS

To do analysis of AODV and augmented AODV routing protocol, four important performance parameters are considered:

1. Packet delivery ratio
2. Throughput
3. Spectral Efficiency
4. Normalized Routing Load

Figure 1 shows that augmented AODV using clustering performs far better than simple AODV in terms of packet delivery ratio. Although the performance generally decreases with the increase in speed the vehicles, augmented AODV outperforms simple AODV. This is so because augmented AODV have stable clusters with good communication handling capacity. Thus resulting in few packet losses and subsequent packet retransmissions.

Throughput is calculated and analyzed at Fig. 2 by varying the speed of the vehicles. From the figure it is clear that augmented AODV performs better than simple AODV.

Figure 3 shows spectral efficiency for both the augmented AODV and simple AODV. The graph is plotted by varying the speed of the vehicles. From the figure it is clear that performance of the augmented AODV is always better than simple AODV even with varying speed.

Figure 4 shows the performance of the augmented AODV and simple AODV by considering the normalized routing load. In this case also performance of the augmented is better than simple AODV. This is so because under all condition (varying speed), the normalized routing load for augmented AODV is always less than the simple AODV.

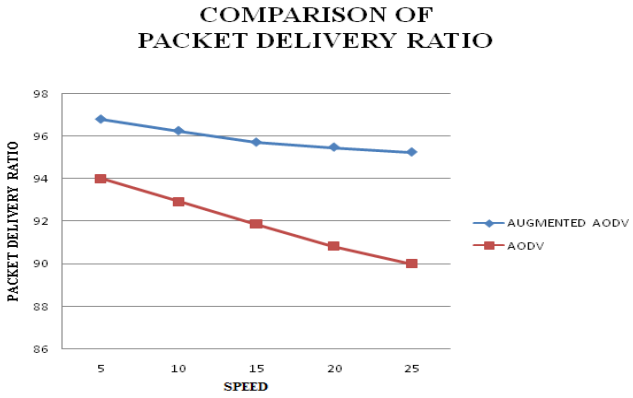

Fig 1. Packet delivery ratio v/s speed

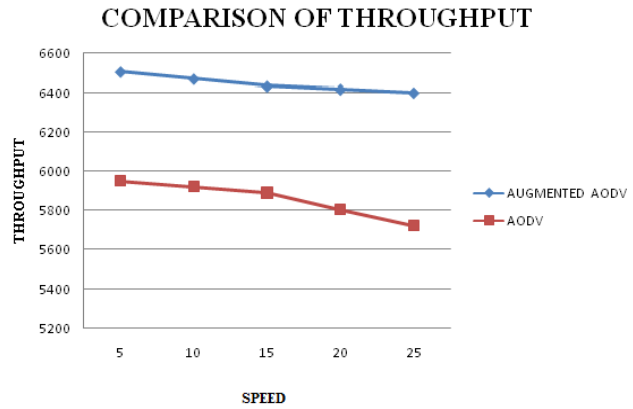

Fig 2. Throughput v/s speed

Fig 3. Spectral efficiency v/s speed

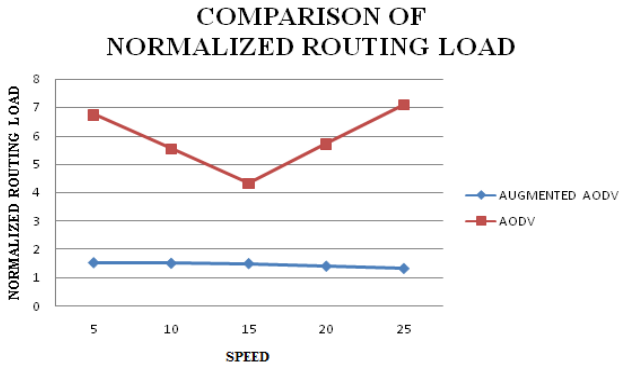

Fig 4. Normalized routing load v/s speed

V. CONCLUSION

As per the simulation results that we have obtained, we can conclude that augmented AODV using clustering outperforms the simple AODV. It gives high throughput, packet delivery ratio, spectral efficiency while giving minimum normalized routing load. Through this paper we get the knowledge that when clustering algorithm are implemented properly than the performance of the vehicular ad hoc network are improved.

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